Talking Points : Enewetak-Ujelang Local (EULG) Government Briefing

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Outline

1. Preliminary Analysis of Groundwater – Runit Dome Project

2. IAEA Technical Cooperation Program

3. Discussion on Future Work

Preliminary Analysis of Groundwater – Runit Dome Project

Timeline, Significant Activities and Deliverables

March 2012, CONTUINUED MONITORING OF RUNIT ISLAND: Cactus Crater Containment and Groundwater Monitoring (PL 112-149) signed by President Obama.

August 2013, Conducted a visual survey of Runit Dome, published a subsequent report (available online at https://marshallislands.llnl.gov), and identified need to include a vine eradication and concrete cap maintenance program.

August 2015, Together with a structural engineer/concrete expert, conducted a inspection of Runit Dome to assess possible damage caused by Tropical Storm Nangka. Reviewed growth of vegetation and rooting vines. Performed pump testing to 'clean out' (develop) the CD-17 dome borehole and two other historical off-dome National Academy Sciences (NAS) groundwater sampling wells. Tested and refined water sample collection protocols. Deployed a borehole well camera. Collected pressure transducer sensor data to track tidal fluctuations in the height of water inside the well pipes.

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Timeline, Significant Activities and Deliverables

December 2015, Conducted pump testing and collected groundwater samples from the CD-17 borehole (preliminary data are shown here in this briefing document).

January 2016, Purchased and took delivery of a reconditioned Fraste XL Multidrill, and published an associated RFP background document (LLNL-MI-684997) on proposed work to be conducted under the next phase of the project.

August 2016

i. Under the direction of a concrete engineer, collected a series of concrete cap core samples (total of 40 concrete cores) from Runit Dome for physical and chemical testing;

ii. Conducted a time series groundwater sampling experiment on the CD-17 dome borehole to evaluate the influence of short-term tidal fluctuations on water quality;

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Timeline, Significant Activities and Deliverables

iii. Conducted a thorough cleanup of the concrete cap covering Runit Dome including the eradication of rooting vines;

iv. Conducted an assessment of external gamma exposure rates on and around Runit Dome;

v. Conducted a short-term air resuspension experiment to determine background concentrations of plutonium in air on and around Runit Dome; and,

vi. Installed anti-tamper shelters (stove-pipes) over groundwater sampling wells.

Preliminary Analysis of Groundwater – Runit Dome Project

1. Radioactivity

Water Quality Parameter	Units	Unfiltered Groundwater (15EY304)		Filtered Groundwater (15EY0300)		Drinking Water Maximum Contaminant Levels (MCLs) or other Applicable Standards	Method Code or Instrumentation
		Value	MDC or RL	Value	MDC or RL		
^{90}Sr	Bq L^{-1}	6.30±0.08	0.015	5.98±0.08	0.013	0.30	EPA 905
^{137}Cs	Bq L^{-1}	2.15±0.04	0.01	2.36±0.04	0.01	7.4	LLNL_Gamma
$^{239+240}Pu$	mBq L^{-1}	0.73±0.02	0.0007	0.77±0.02	0.0007	555	LLNL_AMS
Tritium	Bq L^{-1}	3.3±0.1	0.02	3.5±0.1	0.02	740	LLNL_tritium
^{129}I	µBq L^{-1}	63±3	0.04	64±4	0.04	37,000	LLNL_AMS
Gross Alpha	Bq L^{-1}	<0.9	0.9	<0.7	0.7	0.55	EPA 900.0
Gross Beta	Bq L^{-1}	18.8±1.2	1.7	20.9±1.2	1.7	0.30	EPA 900.0

Reference date = 12/05/15

Definitions:

ND - Indicates that the analyte was not detected at the reporting or detection limit

MDC - Minimum Detectable Concentration (Detection Limit)

RL - Reporting Limit

1 mBq = 1 x 10^{-3} Bq (0.001 Bq)

1 µBq = 1 x 10^{-6} Bq (0.000001 Bq)

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2. General Parameters

Water Quality Parameter	Units	Unfiltered Groundwater (15EY304)		Filtered Groundwater (15EY0300)		Drinking Water Maximum Contaminant Levels (MCLs) or other Applicable Standards	Method Code or Instrumentation
		Value	MDC or RL	Value	MDC or RL		
Salinity	ppt	4.2	0.1	4.2	0.1	_	YSI *Inc.*
pH	pH units	12.21	0.05	12.21	0.05	6.5-8.5	ThermoFisher Scientific
Total Hardness	mg L^{-1}	2200	83	2200	83	<61 (considered Soft)	EPA 200.7, as $CaCO_3$
Sodium	mg L^{-1}	2100	1	1800	1	30-60	EPA 200.7
Chloride	mg L^{-1}	4100	500	4200	500	250	EPA 300.0
Floride	mg L^{-1}	ND	2.5	ND	2.5	4	EPA 300.0
Nitrate	mg L^{-1}	ND	50	ND	50	10	EPA 300.0, as N
Nitrite	mg L^{-1}	ND	50	ND	50	1	EPA 300.0, as N
ortho-Phosphate	mg L^{-1}	ND	75	ND	75	_	EPA 300.0, as P
Sulfate	mg L^{-1}	460	7.5	460	75	250	EPA 300.0

Definitions:
ND - Indicates that the analyte was not detected at the reporting or detection limit
MDC - Minimum Detectable Concentration (Detection Limit)
RL - Reporting Limit

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3. Heavy Metals, other

Water Quality Parameter	Units	Unfiltered Groundwater (15EY304)		Filtered Groundwater (15EY0300)		Drinking Water Maximum Contaminant Levels (MCLs) or other Applicable Standards	Method Code or Instrumentation
		Value	MDC or RL	Value	MDC or RL		
Arsenic	$\mu g\ L^{-1}$	15	1	15	1	10	EPA 200.8
Beryllium	$\mu g\ L^{-1}$	ND	1	ND	1	4	EPA 200.8
Cadmium	$\mu g\ L^{-1}$	ND	1	ND	1	5	EPA 200.8
Chromium	$\mu g\ L^{-1}$	ND	10	ND	10	100	EPA 200.8
Copper	$\mu g\ L^{-1}$	ND	5	ND	5	1000	EPA 200.8
Lead	$\mu g\ L^{-1}$	ND	1	ND	1	15 (action level)	EPA 200.8
Selenium	$\mu g\ L^{-1}$	52	10	55	10	50	EPA 200.8
Mercury	$\mu g\ L^{-1}$	ND	0.2	ND	0.2	2 (inorganic)	EPA 245.1
Sulfate Reducing Bacteria	CFU mL^{-1}	Absent		Absent		–	SRB-BART™ System, EMSL M122

Definitions:
ND - Indicates that the analyte was not detected at the reporting or detection limit
MDC - Minimum Detectable Concentration (Detection Limit)
RL - Reporting Limit

Preliminary Analysis of Groundwater – Runit Dome Project

General Findings

- Groundwater collected from a single borehole (CD-17) inside Runit Dome meets most U.S. EPA MCLs quality standards for radioactivity in water.
- The one exception found is for Strontium-90 (^{90}Sr).

  ^{90}Sr ~ exceeds the recommended MCL value by a factor of about 20-fold (20 x)
- Outside of general drinking water quality parameters affected by the sea salt content of the groundwater, we observed no significantly elevated concentrations of other potentially toxic elements in the groundwater samples.
- The anomalously high pH reading (pH ~12.2) of the groundwater is most likely driven by cement-water interactions and development of a strong carbonate-bicarbonate ion buffer capacity within the saturated zone.

pH is a measure of the acidity and alkalinity of a solution. On a scale between 0 and 14, a value of 7 represents neutrality. Lower values indicate increasing acidity and higher values increasing alkalinity. Each unit of change represents a tenfold change in acidity or alkalinity. pH 12.2 groundwater is considered very alkaline in nature and is likely to have some impact on radionuclide leaching and mobility from the waste pile.

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Remarks

- In general, with the exception of ^{90}Sr, the concentration of fallout radionuclides measured in groundwater beneath Runit Dome fall in a range that is comparable with or less than U.S. EPA water quality standards.
- At the same time, the concentration of key fallout radionuclides measured in groundwater from Runit Dome is significantly elevated over levels observed in lagoon and open ocean water (refer to summary tabulation below).

Table 1. Summary Tabulation of Radionuclides in Different Water Bodies

Water Quality Parameter	Units	Runit Dome Groundwater (this study)	Enewetak Atoll Lagoon#	North Pacific Ocean#
^{90}Sr	mBq L^{-1}	6000	<1 - 5	<0.1 - 1.5
^{137}Cs	mBq L^{-1}	2000	<2-10	<0.1 - 2.8
$^{239+240}Pu$	mBq L^{-1}	1	0.05-0.5	<0.0005- 0.005
^{40}K (Natural)	mBq L^{-1}	_	12,000	12,000
Uranium (Natural)	mBq L^{-1}	_	100	100

#Estimated range; Definitions: 1 mBq = 1 x 10^{-3} Bq (0.001 Bq)

Preliminary Analysis of Groundwater – Runit Dome Project

Remarks, cont'd

- The higher levels of radioactive contamination found in groundwater beneath Runit Dome compared with that found in the lagoon do support a hypothesis that migration of groundwater away from the site boundary of Runit Dome could lead to increases in the total radiation burden within the local marine environment.
- The historical view has always been that any releases from Runit Dome will be dwarfed by existing levels of contamination inside the lagoon and were therefore of not real significance.
- In contrast, the aim of the Runit Project under PL 112-149 is to attempt to quantify the magnitude of any leakage of radioactive waste from Runit Dome into the environment, and then assess if these releases will have a measureable impact on radiation exposure and the health of the local resident population.

Preliminary Analysis of Groundwater – Runit Dome Project

Remarks, cont'd

- Under the work plan, we hope to establish several groundwater sampling sites both inside (N=3) and off (N=3) Runit Dome. These additional sampling sites are needed in order to conduct an accurate and scientifically defensible assessment and build understanding of environmental conditions that may affect the time evolution of water quality and releases of radioactive contamination into the near-surface marine environment. This could include short and long-term variations caused by diurnal tidal cycles, high tide events, high winds, heavy rainfall and/or major storms.

IAEA Technical Cooperation Project

Title : IAEA TC Project MHL7001, Developing a National Radioactivity Monitoring Capacity

Gap / Problem / Need Analysis: This project proposal aims to develop a national capacity to measure artificial radionuclides in the marine, terrestrial and coastal environment of the Marshall Islands. The Fukushima accident released more than 1015 Bq of radiocesium (^{137}Cs and ^{134}Cs) to the Pacific marine environment. This point-source release to the N-W Pacific Ocean represented about 10% of the total inventory of radiocesium dispersed around the globe from the Chernobyl accident. The dispersion of radioactive contaminants from Fukushima through the air and by ocean currents highlighted the need to develop a radiological assessment capacity in the Marshall Islands. The ability to develop baseline data on artificial radionuclides entering terrestrial waters of the Marshall Islands will help attest to any direct impacts associated with the Fukushima accident. The same could be said of any future accidents or events involving the release of radioactive contaminates to the Pacific Ocean. The Marshall Islands is also cognizant of the fact that nuclear energy production in the Asia-Pacific region is expanding, and as a nation we need to have some capacity to respond to nuclear events. Furthermore, the U.S. atmospheric nuclear weapons testing program at Bikini and Enewetak Atolls in the northern Marshall Islands (1946-58) had a profound impact on the natural landscape and people of the Marshall Islands. The nuclear test program left behind a legacy of distrust of U.S. authorities and a chronicle of unanswered questions. Select local atoll governments in partnership with U.S. Government agencies have implemented a number of strategic initiatives over the past decade to improve radiological surveillance measures. However, the fact remains that the RMI Government has no independent capacity to provide verification monitoring of marine and terrestrial foods, air, water and soil. The successful implementation of this project will lead to improved public awareness of radiological conditions in the Marshall Islands, and strategies and actions to development meaningful programs to assess and improve food safety and security. The ability to conduct national studies in radiological protection and measurement will act to build a more equitable and trustworthy relationship with U.S. agencies. As a nation, the RMI needs to be able to make more informed decisions on issues related to radiation exposure, remediation and resettlement of islands and atolls, and general radiological safety and health.

IAEA Technical Cooperation Project

Title : IAEA TC Project MHL7001, Developing a National Radioactivity Monitoring Capacity

Background

- Prepared draft proposal for submission by the RMI to the IAEA (attempted to use national and regional concerns over Fukushima as an added justification to fund the project).
- Approved by the IAEA Board of Governors during November 2015 (only partially funded – no funding for essential equipment).
- LLNL/DOE working with the IAEA and US agencies in effort to help fund this capacity building project to develop an independent radioactivity measurement lab in the RMI.
- LLNL hosting two fellows from MIMRA during Jan-Feb. 2017.
- Personally welcome local atoll leadership efforts to help galvanize RMI national government support for this project.

Discussion on Future Work

Discussion Points

1. DOE-RMI annual meeting.

2. Completed a very successful summer mission (field samples due to arrive LLNL sometime this week).

   - Hope to have some data available to present at the next annual meeting

3. LLNL will welcome feedback on an initial draft report on measurement of contaminants in groundwater samples collected from Runit Dome (to be made available in the next few weeks).

4. Propose to conduct a community meeting on Enewetak Atoll during 2017.

5. Other concerns or issues

KOMMOL TATA